

(12) **United States Patent**
Nguyen et al.

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(54) **TEMPORAL LASER PULSE MANIPULATION
USING MULTIPLE OPTICAL
RING-CAVITIES**

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Related U.S. Application Data

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(51) **Int. Cl.**
H01S 3/082 (2006.01)

(52) **U.S. Cl.** **372/97; 372/30; 372/92; 372/94; 356/300; 356/301; 356/303**

(58) **Field of Classification Search** 372/30, 372/92, 94, 97; 356/300, 301, 303
See application file for complete search history.

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(57) **ABSTRACT**

An optical pulse stretcher and a mathematical algorithm for the detailed calculation of its design and performance is disclosed. The optical pulse stretcher has a plurality of optical cavities, having multiple optical reflectors such that an optical path length in each of the optical cavities is different. The optical pulse stretcher also has a plurality of beam splitters, each of which intercepts a portion of an input optical beam and diverts the portion into one of the plurality of optical cavities. The input optical beam is stretched and a power of an output beam is reduced after passing through the optical pulse stretcher and the placement of the plurality of optical cavities and beam splitters is optimized through a model that takes into account optical beam divergence and alignment in the pluralities of the optical cavities. The optical pulse stretcher system can also function as a high-repetition-rate (MHz) laser pulse generator, making it suitable for use as a stroboscopic light source for high speed ballistic projectile imaging studies, or it can be used for high speed flow diagnostics using a laser light sheet with digital particle imaging velocimetry. The optical pulse stretcher system can also be implemented using fiber optic components to realize a rugged and compact optical system that is alignment free and easy to use.

17 Claims, 10 Drawing Sheets

